

above 100° C., since otherwise the engine will frequently misfire"; considering that Pratt's spirit usually gives a little under 60 per cent., distilling below 100° C., and many petrol substitutes considerably less, this seems a misleading statement.

On p. 45 we are told that "the vapour pressure must be considered in storing naphtha and other inflammable liquids," but it is now being recognised that the determination of this factor is also of the greatest importance in forming a sound conclusion as to the ease of starting and flexibility in running with a motor spirit, as the amount of vapour given off at atmospheric temperatures governs the formation of the explosive mixture in the cylinder when starting from cold.

Directions are given for determining the vapour tension by introducing the petrol into the Torricellian vacuum above the barometric column in a 10 mm. diameter tube, but a far more simple and practical method is to use the pressure tube devised by Sir Boverton Redwood and Captain Thomson, which is adopted for testing the pressures developed in vessels containing petrol.

Several pages are devoted to the viscosity of oils and testing their lubricating value, and also to the setting point and fluidity of oils, their value for gas-making and tendency to resinification.

The book is, like most of the technical works of German origin, a model of abstracting, and invaluable as giving full references to original work, but its utility is discounted in the laboratory by the absence of practical detail.

Chapter ii. is devoted to natural asphalt, and contains much useful information on the subject; chapter iii. deals with ozokerite and Montan wax; whilst in chapter iv. we come to the important subject of the tars obtained by the distillation of coal, lignite, shale, and peat.

The attention devoted to the recovery of the coal-tar products in Germany led one to hope that this part of the book would contain much valuable information, but unfortunately the subject is not treated very fully, and points of such importance as the differences in tars due to variations in the temperature of carbonisation receive but scanty notice, whilst the use of the products of tar distillation is dismissed with the curt remark that "these are of great importance in the preparation of dye-stuffs and of pharmaceutical products." It might have been expected that special attention would have been devoted at the present time to the detection, estimation, and purification of those tar products used in the production of high explosives, but even the fact that it is the source of the most important explosives of the day is not mentioned.

The saponifiable fats and their technical pro-
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ducts are a very useful section of the book, which ends with a chapter on waxes. Prof. E. Mueller is to be congratulated on the translation of the original German work, and the type, illustrations, and general style are of the excellence always found in Messrs. Wiley's technical publications.

ELECTRICAL ENGINEERING.

(1) *Continuous-current Electrical Engineering.* By W. T. Maccall. Pp. viii+466. (London: University Tutorial Press, Ltd., 1915.) Price 10s. 6d.

(2) *Single-phase Electric Railways.* By E. Austin. Pp. xiv+303. (London: Constable and Co., Ltd., 1915.) Price 21s. net.

(1) **M**R. MACCALL'S book is well above the standard usually found in books which cover such a wide field, and it can be thoroughly recommended, both to engineers and to students. To the latter, the large selection of questions will be of especial value. The book covers the ground indicated by its title about as thoroughly as could be expected in a volume of its size and price; the most noteworthy omission is the subject of primary batteries. More might have been said about electric heating, a little about electric cooking, and electric furnaces might at least have been mentioned.

The chapters on illumination and lamps are very good indeed, and contain little that we would wish to alter. But those on machines, although quite up to the standard of most text-books, are certainly less satisfactory. Here and there the matter is rather weak. Thus the portion dealing with generator characteristics does not show that real grip of the subject which an instructor ought to have. Another point is the geometry of the armature winding diagrams. A developed diagram is shown with the poles behind, the commutator *below*, and the numbers running from left to right; while a radial diagram has clockwise rotation of the numbers. These are not consistent with one another.

We do not think the author has ever tried to separate the no-load losses of a machine in any of the ways he has described, or we should have seen some doubts expressed as to the validity of some of them. In fact, he would probably have found, as we ourselves once did, that the "friction" alone, as determined from the constant speed experiment, *exceeds* the "friction+hysteresis" given by the constant flux experiment. In short, this method won't work, for it assumes that the frictional torque is the same at all speeds, which is very far from the truth. The running down test can be carried out much more simply than in the manner described, and it can be modified

so as to give a complete analysis of the losses in about half an hour after getting the machines into a steady condition.

We are flattered by the graceful acknowledgment that our mode of numbering the illustrations has been adopted, but we would have greatly preferred that in a much more important direction the author had followed the methods we advocate, but cannot claim to have originated. We refer to the practice of making the algebraic symbols stand for *things* and not merely for numbers, so that the formulas will apply irrespective of units. Mr. Maccall seems unable to discuss principles apart from some particular units, with the result that his mathematics is horribly complicated by numbers which have nothing to do with the facts, but arise from the unfortunate, although perhaps customary, choice of units. In some cases we are treated to separate deductions of formulas for inch and metric measure, instead of one formula with two sets of constants. As we said on a former occasion, the laws of nature were exactly the same ages before man ever discovered anything about them, much less invented units in which to express his measurements concerning them. *Make the symbols stand for things and the units will look after themselves.* Formulas will then represent *facts*, and not merely particular numerical relations.

We like the author's special symbol for "number of turns," but we object to making his other new symbol do double duty by using it both for "current $\times$ turns" and for the name of the unit "ampere-turn."

For the new edition, which we confidently expect, we hope that the publishers will adopt a paper suitable for reproducing the half-tone blocks. Fortunately, these form only a small proportion of the illustrations, but where they do occur they entirely spoil the appearance of the book, while at the same time they are seldom sufficiently distinct to be of any real use.

(2) "Single-phase Electric Railways" gives an outline description, with leading data, of all the important lines of this type which have so far been constructed. Although most of the matter has already been published in the columns of the *Engineer*, it is convenient to have it all collected together for ready reference. For that reason, it is unfortunate that the author has decided not to deal fully with the motor itself, and also that he has not included a great deal more data regarding the operating costs, of which much has been made public during the past few years.

The book is abundantly and well illustrated by drawings and photographs; indeed, the latter take such a very prominent place as to almost form

the *raison d'être* of the book. The overhead construction is taken in fairly full detail, but the particulars of the motors and controlling gear are somewhat meagre. Diagrams of connections are certainly there, but the written description is generally too slight, except for the expert.

The first chapter of three pages is mainly historical, but just touches on the thorny battle of the systems. More eloquent than all the opinions of the author and the experts is the fact, brought out in a recent number of the *General Electric Review*, that since the advent of the high-voltage continuous-current system, the mileage of single-phase railways has been practically stationary, while that of the continuous-current system has gone up by leaps and bounds, and now far surpasses its rival. It would have been far better if this chapter had given an account of the general principles underlying single-phase railway working, and a closely reasoned account of the difficulties arising from it, the way in which these have been overcome, and the relative advantages and disadvantages of the system. A comparison of the solutions found for these difficulties in the various lines described further on would have served to weld the book into a homogeneous whole, instead of leaving it in twenty-three watertight compartments (one for each line described), with no connection between them but the common title to the whole book.

We may conclude by saying that to the expert and to the student of railway engineering, the book will be of especial value as a work of reference, diminished although that is by the lack of references to other publications. Others may find it interesting, for the style is good and the matter is made as readable as a catalogue (for such it really is) well can be. DAVID ROBERTSON.

THE LIMITATIONS OF SCIENCE.

(1) *The Limitations of Science.* By Prof. L. T. More. Pp. vii+268. (New York: H. Holt and Co., 1915.) Price \$1.50 net.

(2) *The Magic of Experience.* A Contribution to the Theory of Knowledge. By H. Stanley Redgrave. Pp. xv+111. (London: J. M. Dent and Sons, Ltd., 1915.) Price 2s. 6d. net.

(1) PROF. MORE has written a study from a conservative point of view of the limitations of science as shown in modern physical views. "Will the results of experiment made objectively which must, however, be interpreted subjectively, fail in their turn as criteria of truth?" (p. 2). "Science, . . . like philosophy, has no ontological value. Should not the men of science clearly recognise this fact, and confine